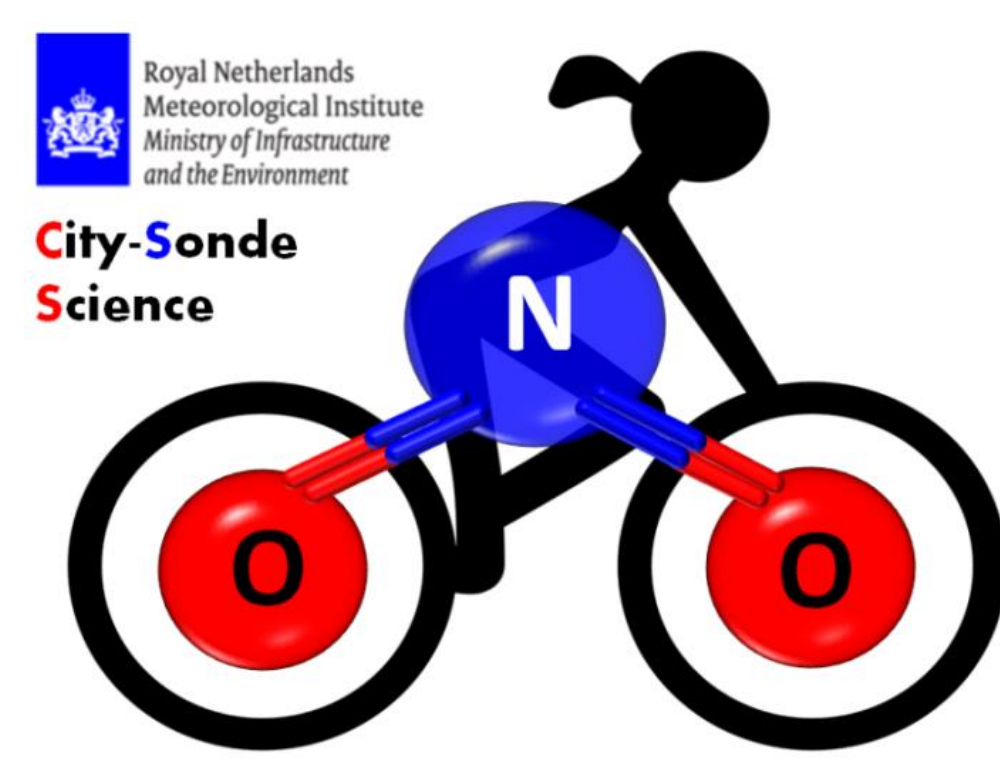


# Using DISCOVER-AQ and KNMI NO<sub>2</sub>-sonde data for OMI validation



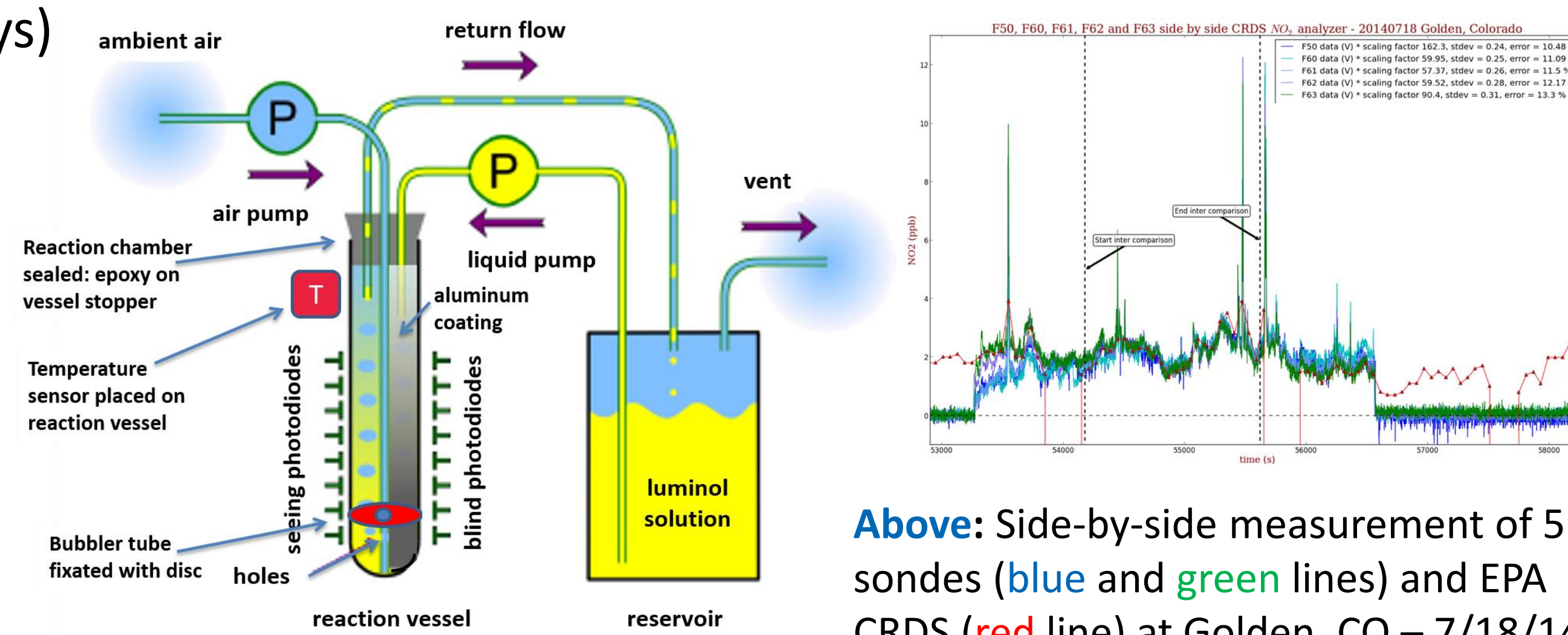
Koninklijk Nederlands  
Meteorologisch Instituut  
Ministerie van Infrastructuur en Milieu

Deborah Stein Zweers (stein@knmi.nl), Mirjam den Hoed, Ken Pickering, Rich Clark

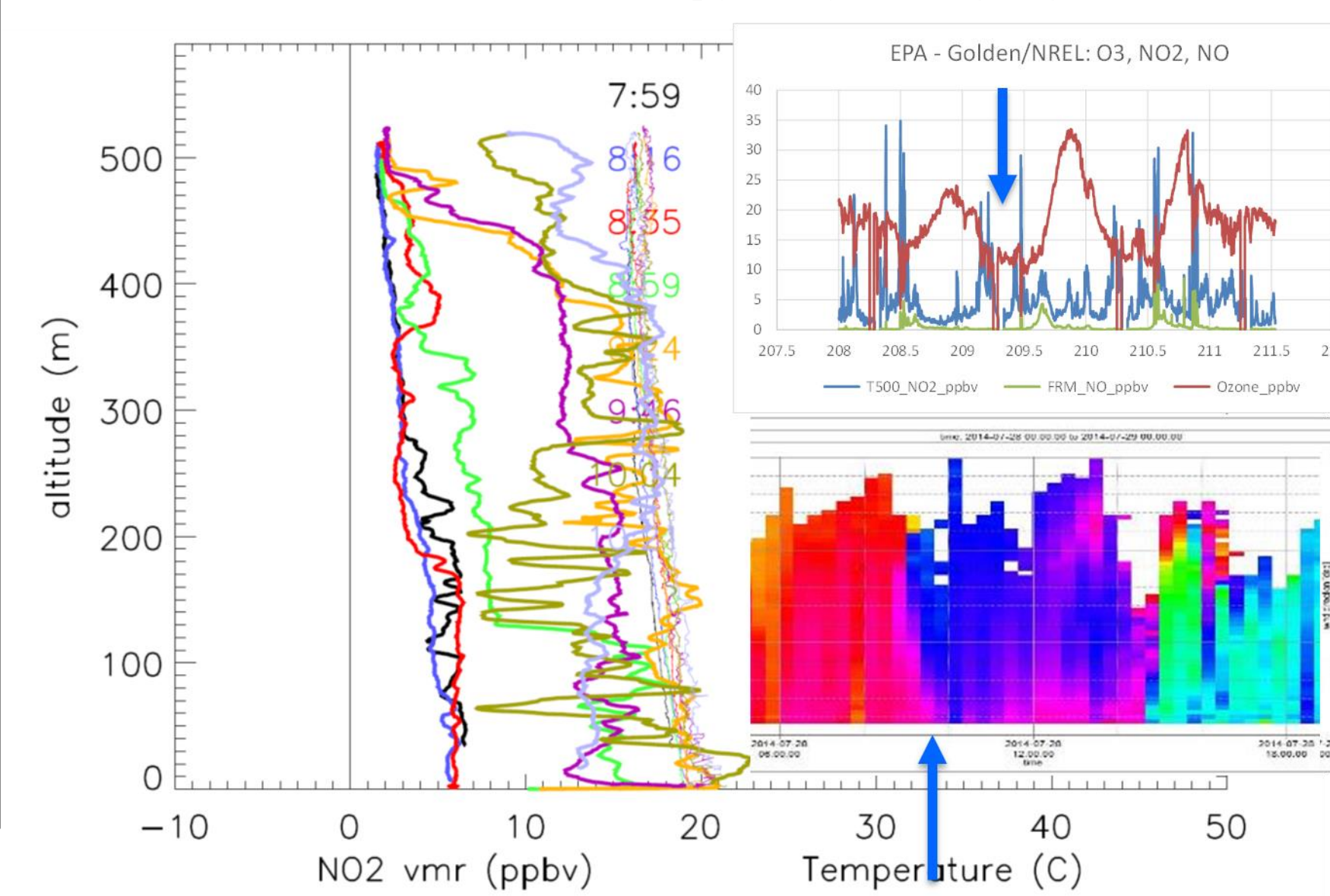
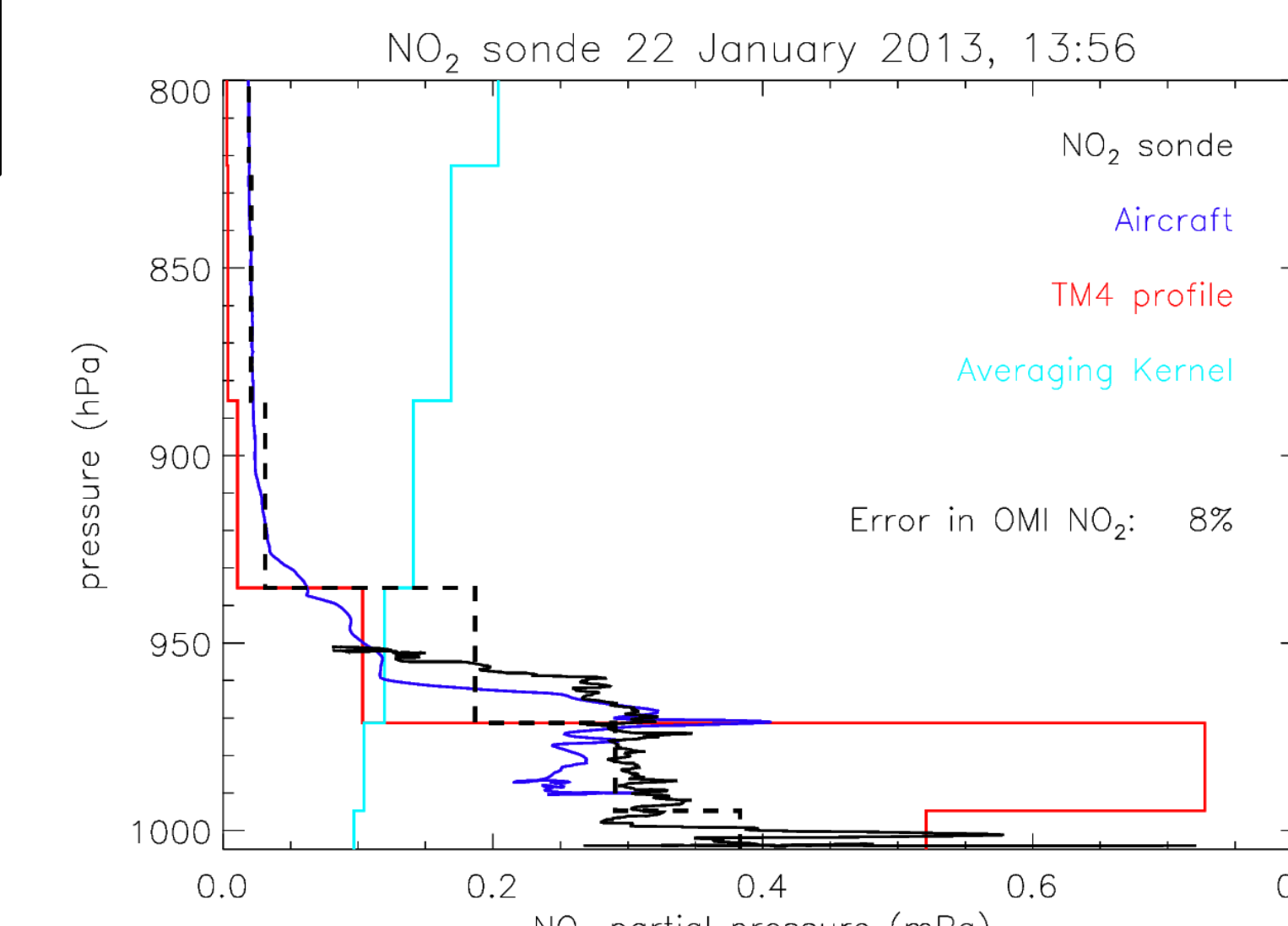
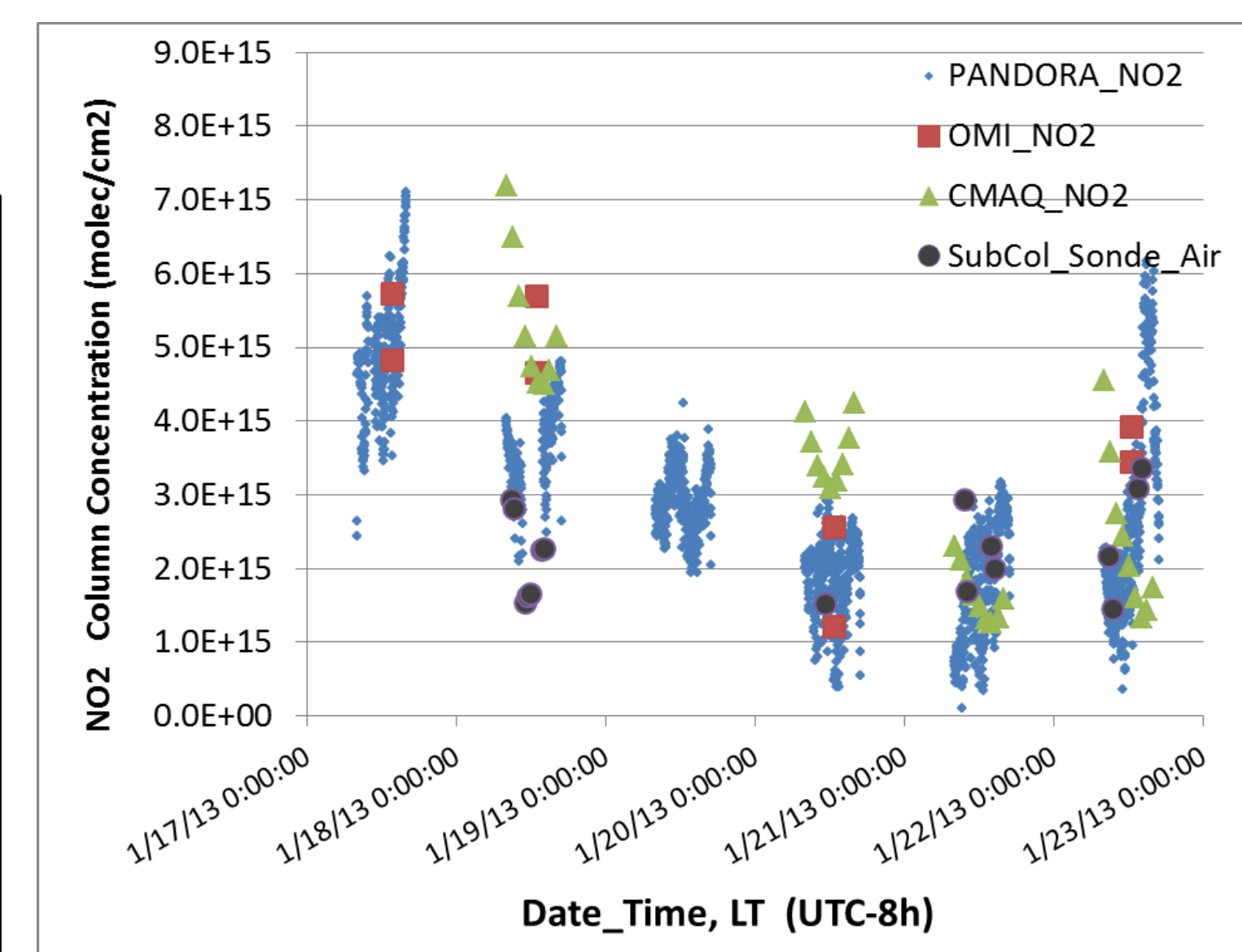


## KNMI NO<sub>2</sub>-Sonde: Instrument Overview

- Runtime:** reservoir dependent (hours to days)
- Sampling:** 1 second
- Accuracy:** +/- 1 ppbv
- Range:** 1-100 ppbv
- Method:** Chemiluminescence
- Deployment:** lightweight, weather balloon, tethered balloon, aircraft, UAV, mobile lab, ground stations, bicycle



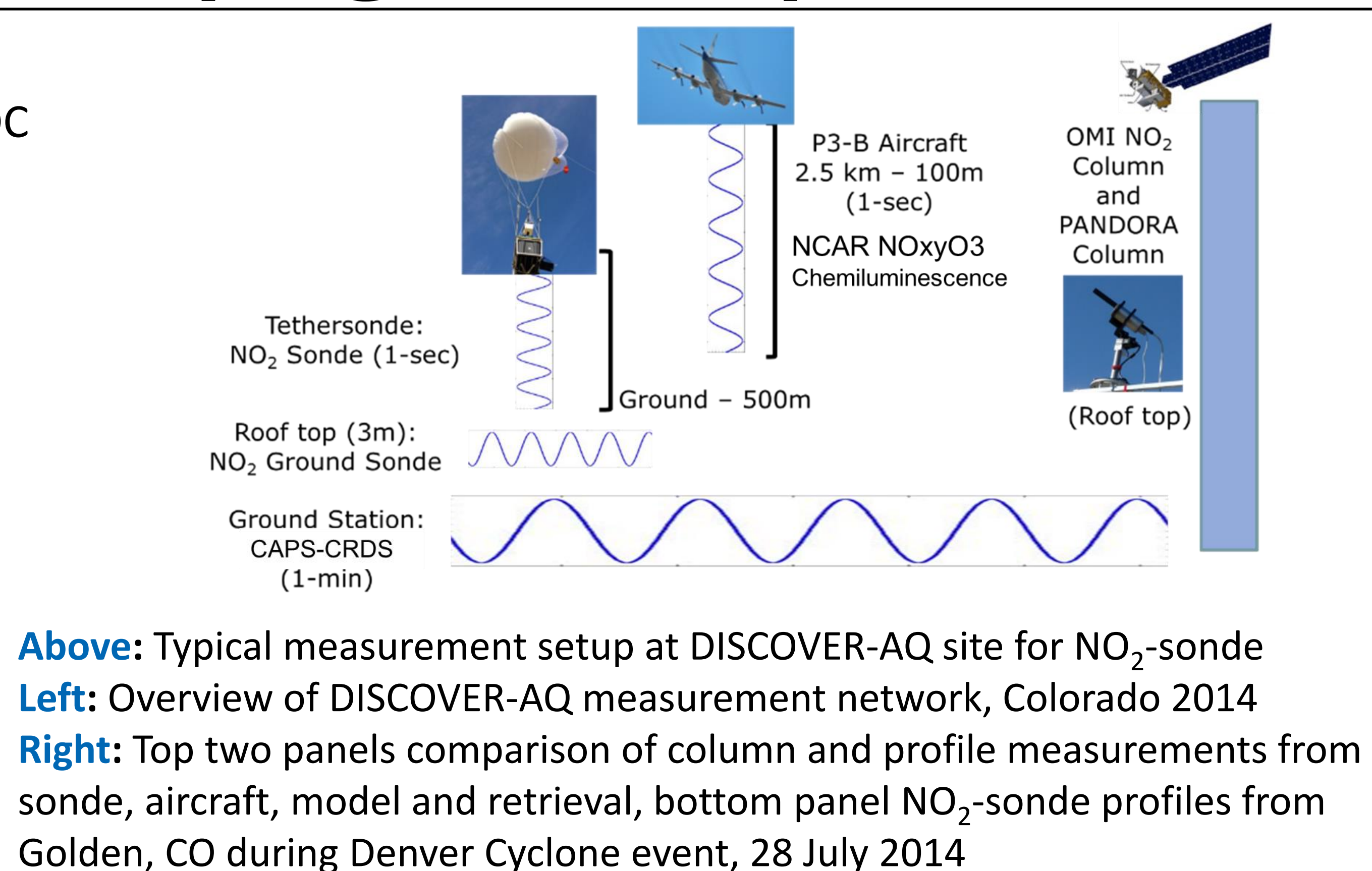
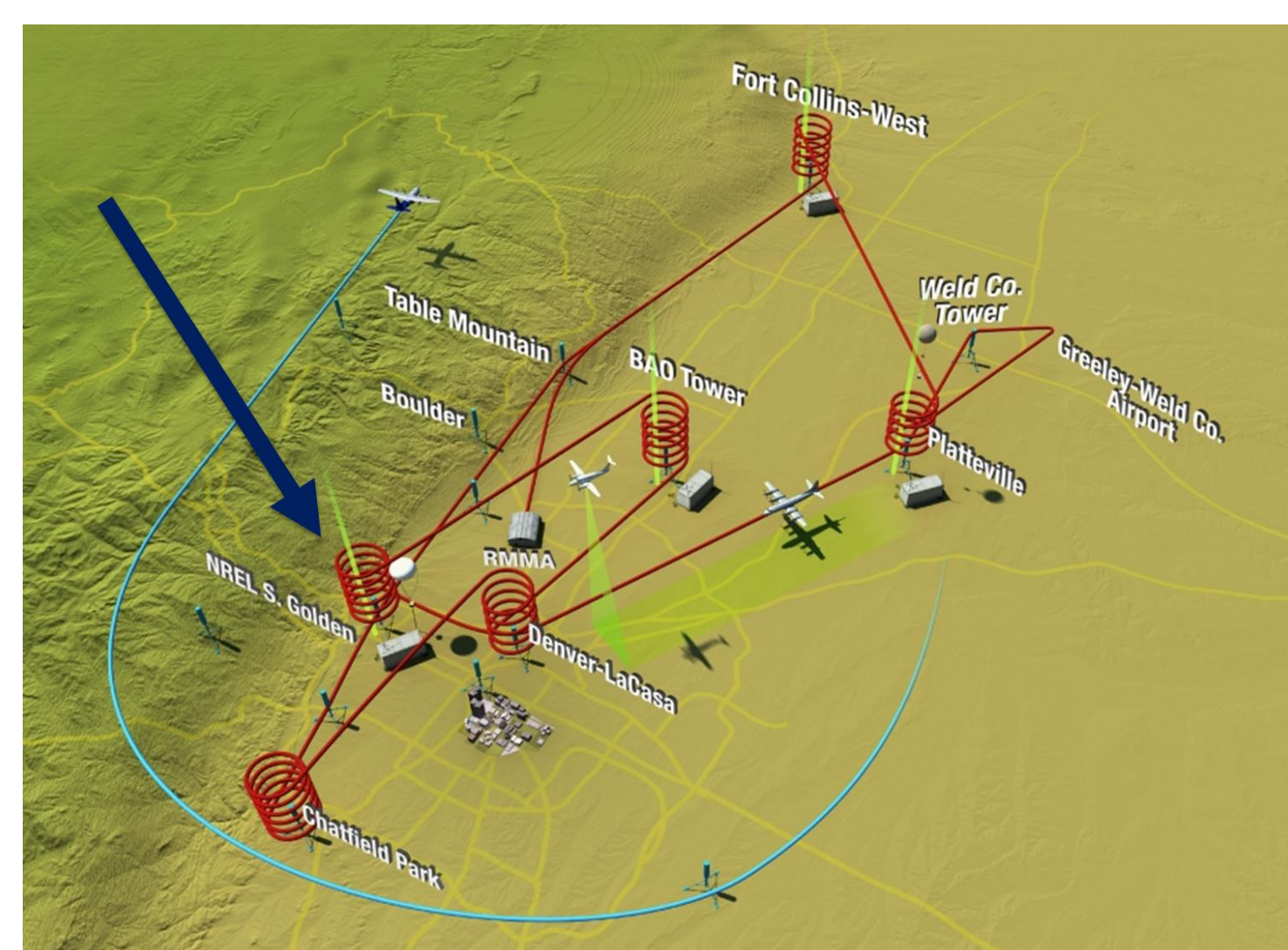
Above: Side-by-side measurement of 5 sondes (blue and green lines) and EPA CRDS (red line) at Golden, CO – 7/18/14



## DISCOVER-AQ: Campaign Participation

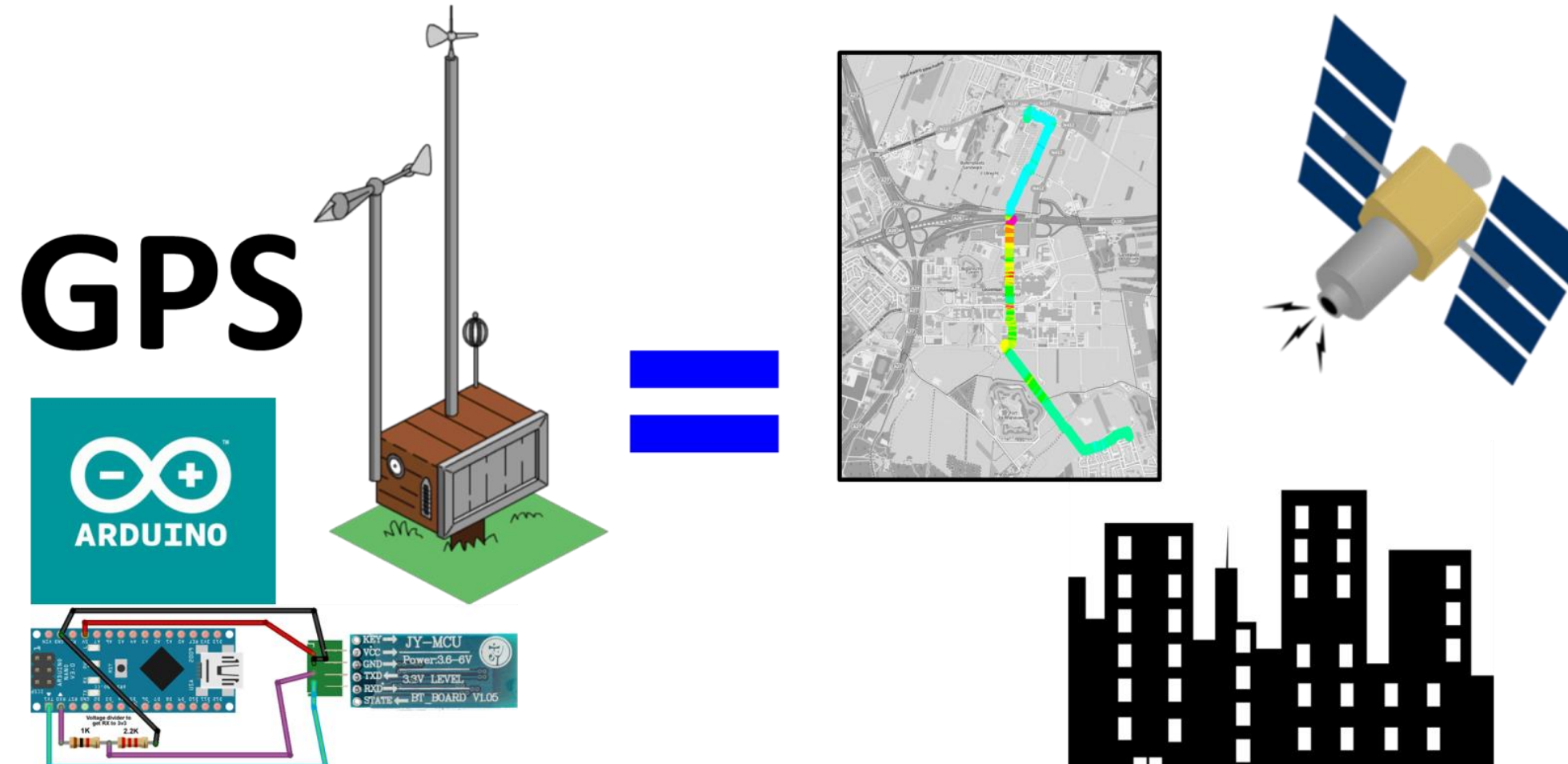
### Campaign Dates and Locations:

- July 2011, Baltimore/Washington DC
- Jan-Feb 2013, Central California
- Sep 2013, Greater Houston Area
- Jul-Aug 2014, Greater Denver Area

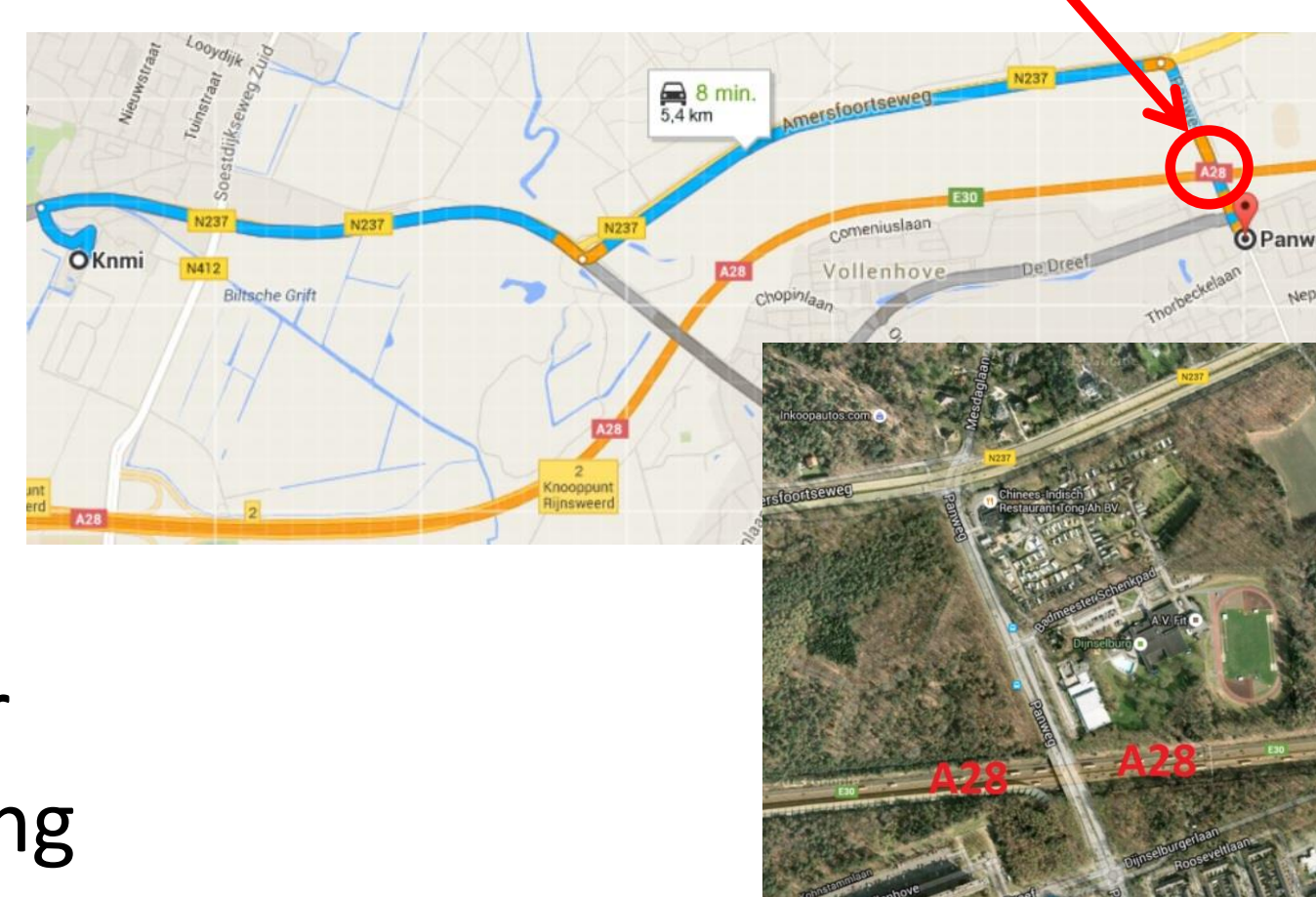


Above: Typical measurement setup at DISCOVER-AQ site for NO<sub>2</sub>-sonde  
Left: Overview of DISCOVER-AQ measurement network, Colorado 2014  
Right: Top two panels comparison of column and profile measurements from sonde, aircraft, model and retrieval, bottom panel NO<sub>2</sub>-sonde profiles from Golden, CO during Denver Cyclone event, 28 July 2014

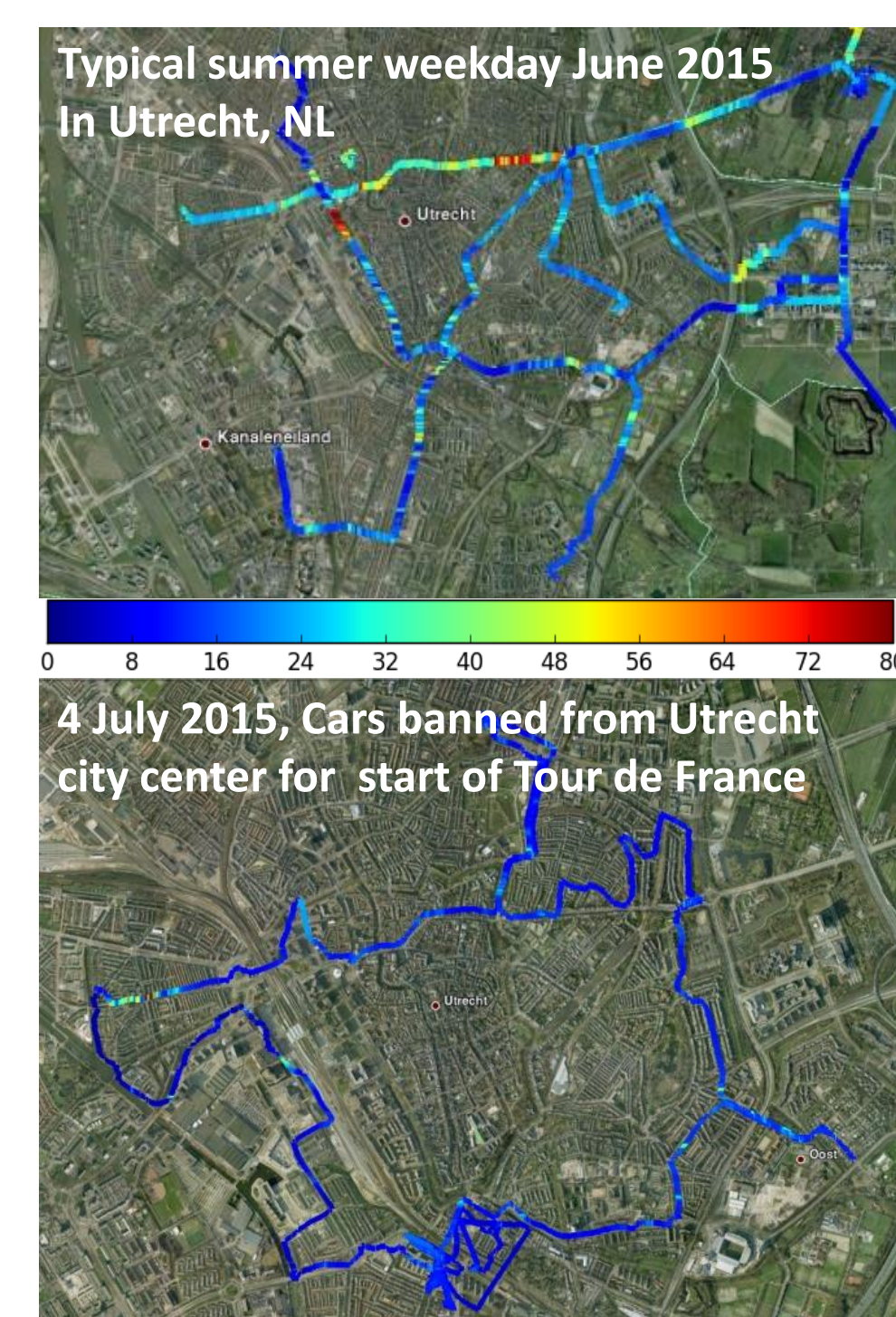
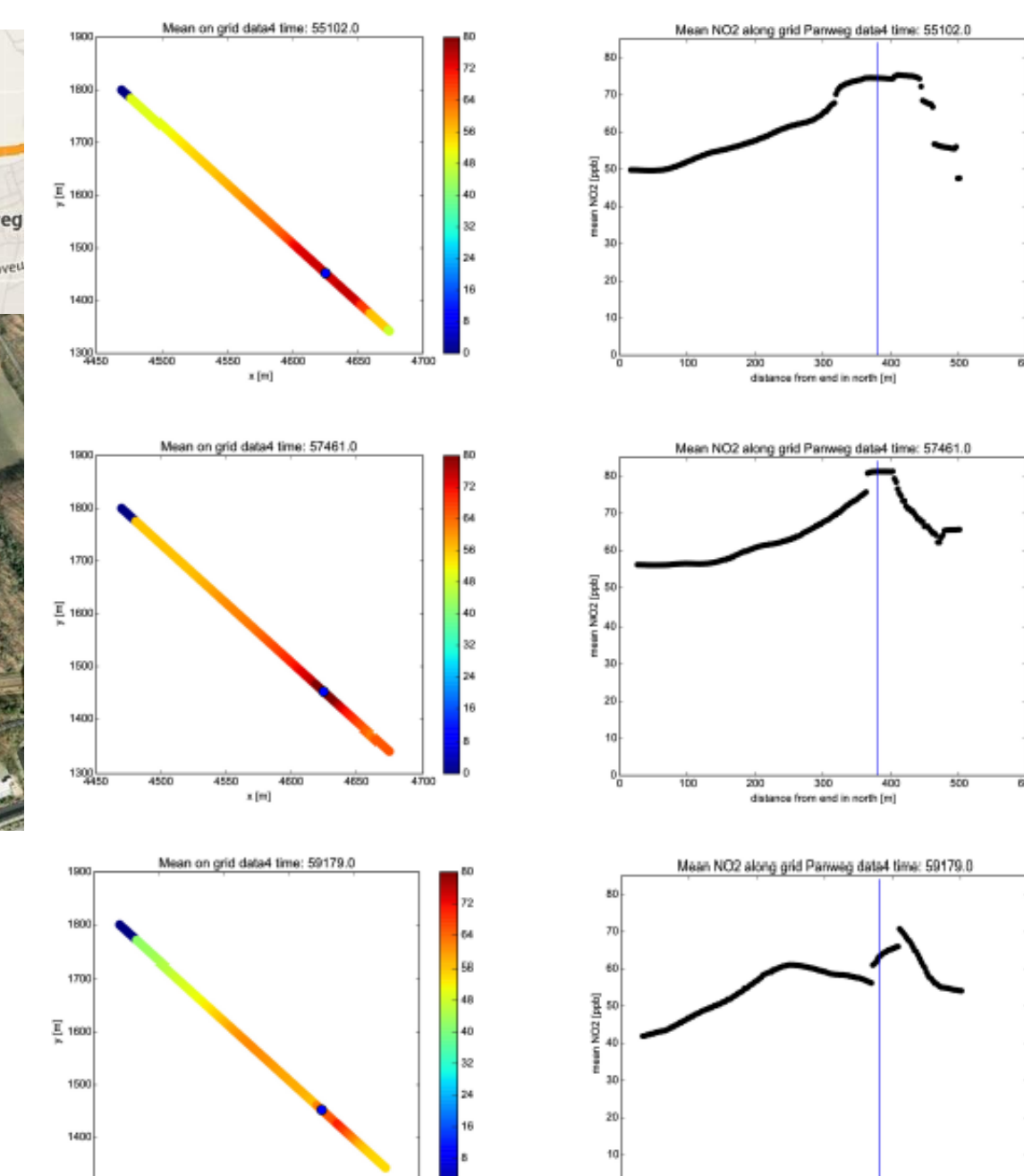
## City-Sonde Science: 1 year and counting



- Goal of City-Sonde Science (CSS):** City-scale air quality study aimed at utilizing citizen science and high temporal-spatial resolution sampling of NO<sub>2</sub> at ground level
- Method:** KNMI NO<sub>2</sub>-Sonde + Arduino-based data logger, Weather Station with GPS module + Bicycle platform
- Campaign:** More than **400 hours of measurements** from over 20 volunteers; Mostly on weekdays during morning and evening rush hour; Case studies aimed at finding NO<sub>2</sub> hotspots
- Validation?:** Not directly, but the high resolution data (~5m) from this type of measurement is well-suited for studying intrapixel variability, especially TROPOMI (7 x 7 km, 3.5 x 7 km)



Highway gradients near KNMI and detailed city maps of Utrecht:  
Highway gradients plotted by E. Tenner (CSS Student)



## Current and Future Activities:

### CINDI-2, Sep 12-Oct 7, 2016 in Cabauw, NL

- Initialization of European FRM4DOAS network instrumentation
- Comparison with small sensors for mobile and stationary measurements focusing on horizontal variability

### Future ESA Romania Validation Campaigns 2017 – 2018

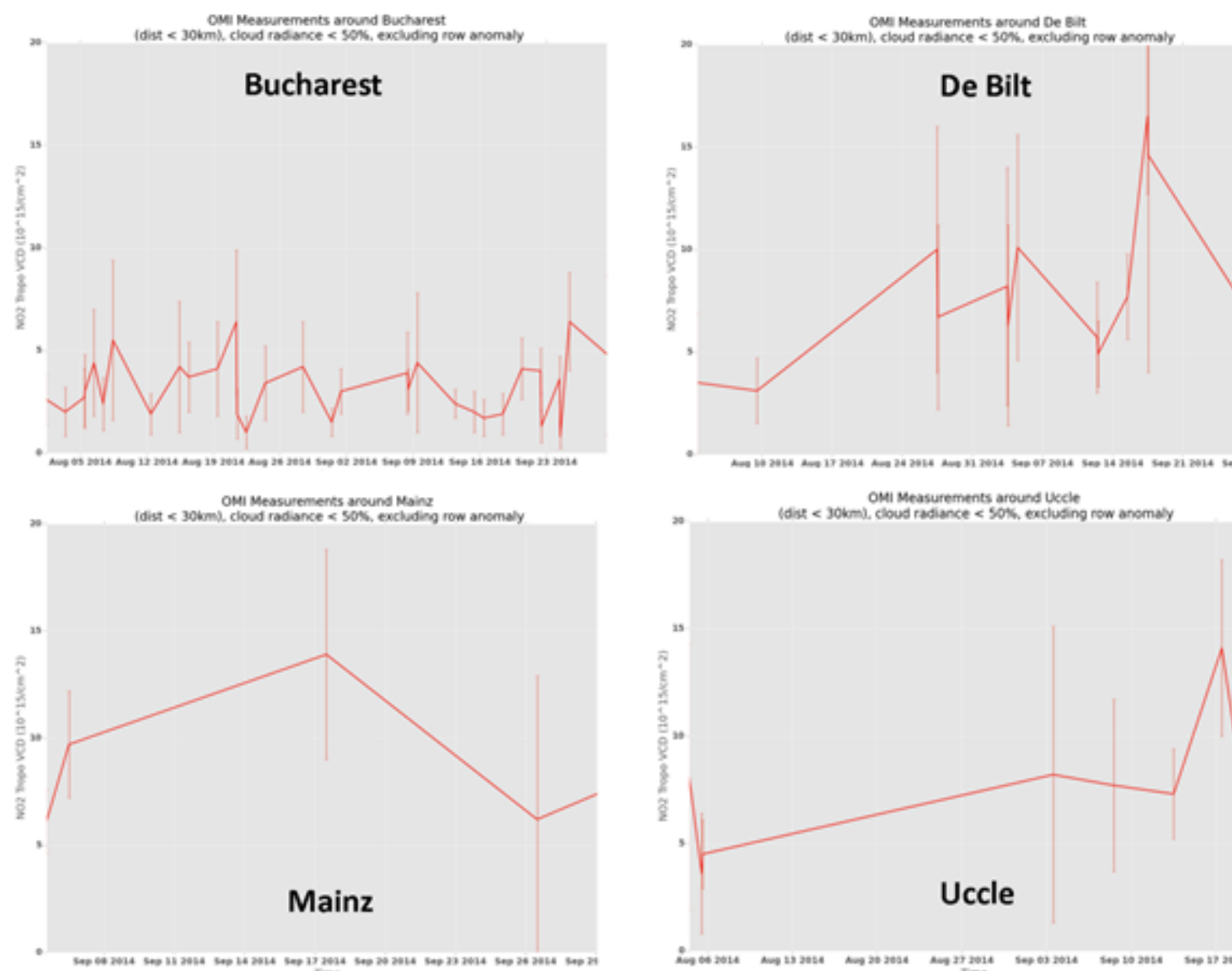
- Building on campaigns in 2014 and 2015, validation for TROPOMI using aircraft and NO<sub>2</sub>-sonde launches

### Future TROPOMI Campaign in Cabauw, NL Spring 2018

- Validation for TROPOMI Sentinel-5 Precursor focused on error characterization for mixed cloud conditions

## Why Romania?

### More opportunity for (TROP)OMI validation



Location	Overpasses	CRF < 50%	Row Anom.	dist < 30 km	OMI left (%)	Trop. VC	Err. Trop. VC	Error %
Bucharest	72	18	18	15	20.8	6.3	4.0	64.0
De Bilt	58	41	41	32	55.2	3.2	1.7	53.1
Mainz	74	14	14	13	17.6	8.0	4.3	54.4
Turceni	68	7	7	5	7.4	8.5	4.5	52.9
Uccle	64	38	35	31	48.4	2.2	1.8	79.3
	67	14	13	9	13.4	7.9	4.8	60.2

Above: Table summarizing percentage of remaining observations (OPS left) after filtering for cloud cover and OMI row anomaly, for Aug-Sep 2014; Bucharest and Turceni, consistently have more coverage than other northern European sites

Left: Comparison of remaining OMI NO<sub>2</sub> (DOMINO) data remaining after filtering for CRF < 50% and row anomaly based on overpass files for 4 European sites (temis.nl)

Results from the AROMAT campaign team: including Alexis Merlaud (BIRA-IASB) & Mirjam den Hoed